MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2021/2022

ERE1036 – BASIC ELECTRONICS

(All Sections / Groups)

7 OCTOBER 2022
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 5 pages including the cover page. There are 4 questions in this final exam.

2. Attempt **ALL** questions. The distribution of marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) Elaborate on the different type of solids namely insulator, conductor and semiconductor, respectively. Sketch an energy diagram to explain each of them. [14 marks]

(b) Given an intrinsic Silicon at T = 300 K with its intrinsic carrier concentration, $n_i = 2.5 \times 10^{10}$ cm^{-3}. The Silicon electron and hole mobilities are $\mu_n = 3800$ cm^2/V-s and $\mu_p = 1800$ cm^2/V-s, respectively at this temperature. Determine the conductivity and resistivity of the intrinsic Silicon sample. [5 marks]

(c) Consider a circuit shown in Figure Q1, use the *piecewise linear diode model* to represent the silicon diode in the circuit. Given resistor $R = 6$ kΩ, $V_\gamma = 0.7$ V, and $R_f = 20$ Ω.

(i) Determine the diode current, I_D.

(ii) Replace the silicon diode with an *ideal model* and repeat the above calculation.

(iii) If V_s is increased to 10 V, determine the new R value in such that I_D is the same value as in Part (ii).

[2+2+2 marks]

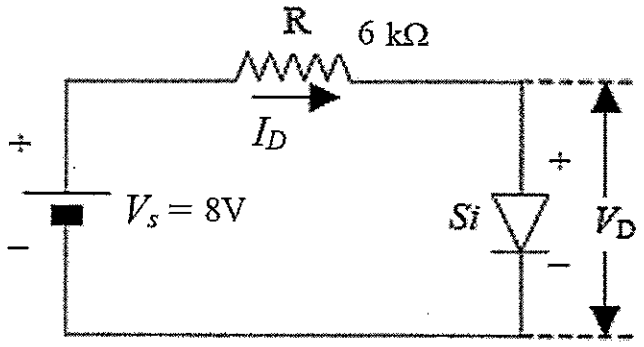

Figure Q1

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Question 2

(a) Figure Q2 shows a rectifier circuit. The step-down transformer in the circuit comes with a turn ratio n = 10:1 and its primary supply source is 210V with 60 Hz. The output resistance R_L is 1 kΩ and the voltage drop across forward-biased diode D is 0.7 V. Determine the following values:

(i) The RMS value of the secondary voltage V_S(rms) . [2 marks]

(ii) The peak input voltage, V_S(m). [2 marks]

(iii) The peak output voltage, Vo(m). [2 marks]

(iv) The average output voltage, Vo(av). [2 marks]

(v) The average Load current, Io(av). [2 marks]

(vi) The RMS output voltage, Vo(rms). [2 marks]

(vii) The RMS Load current, Io(rms). [2 marks]

(viii) The Ripple Factor γ of the output voltage. [4 marks]

(ix) The AC power absorbed by the load, Po(rms). [3 marks]

(x) Sketch the output waveform Vo with respect to the secondary V_S. [4 marks]

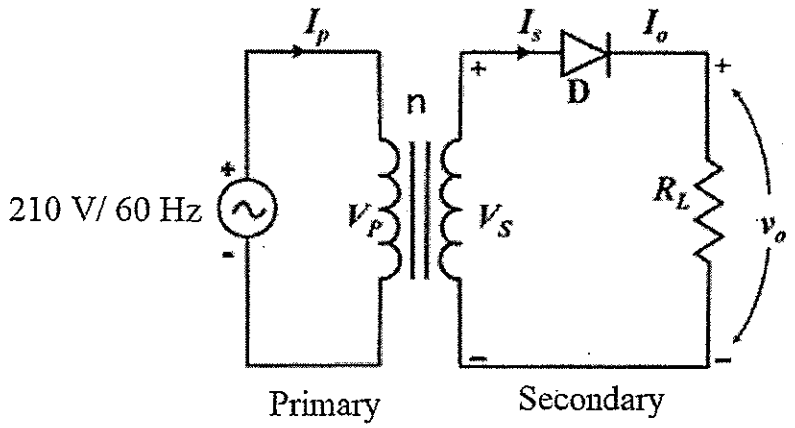

Figure Q2

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Question 3

(a) Sketch the IV characteristics graph for a common-emitter configuration of bipolar transistor (BJT). Add the DC load-line in the graph depicting the DC operating values of this common-emitter amplifier circuit. Choose an overlapped node between BJT characteristic line and the DC load-line to indicate an operating Q point and label all the important nodes on the graph. List down all the steps to determine the DC load-line and the values of the common-emitter amplifier's I_{BQ}, I_{CQ} and V_{CEQ}.

[8 marks]

(b) An emitter-stabilised bias BJT circuit is shown in Figure Q3, with $R_B = 500$ kΩ, $R_C = 1.5$ kΩ, and $R_E = 470$ Ω. Given that the DC amplification factor, $\beta = 100$, $V_{CC} = 12$ V, and $V_{BE} = 0.7$ V. Determine the following:

(i) The base and emitter currents, I_B and I_E. [7 marks]

(ii) The parameters of the Q-point, I_{CQ} and V_{CEQ}. [4 marks]

(iii) The parameters of the DC load line, $I_{C(sat)}$ and $V_{CE(cutoff)}$. [3 marks]

(iv) The power dissipated in the transistor. [3 marks]

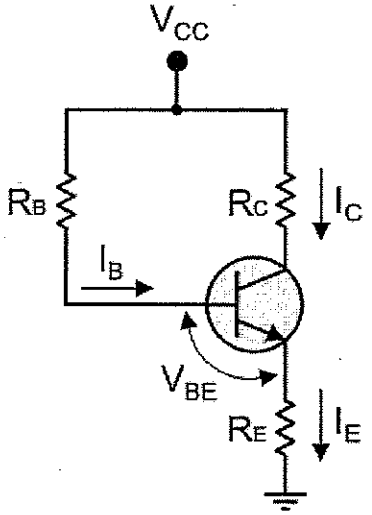

Figure Q3

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Question 4

Figure Q4 shows a common-emitter bipolar junction transistor (BJT) circuit. Assuming an operating temperature of 27°C with the thermal voltage is $V_T = 26$ mV.

(i) Sketch the small signal equivalent circuit of the transistor amplifier using the following transistor models: *h-parameter* model, hybrid-π model and r_e transistor model. Clearly indicate the AC elements of i_b, i_c, v_{be} and v_o in each of the circuit diagram.

[4+4+4 marks]

(ii) Using the approximation method, determine the base voltage (V_B), emitter current (I_E) and base-emitter resistance (βr_e).

[5 marks]

(iii) Determine the effective input impedance, $Z_{in}^{'}$.

[4 marks]

(iv) Determine the effective output impedance, $Z_{out}^{'}$ if a load resistor R_L=1kΩ is connected to Vo.

[4 marks]

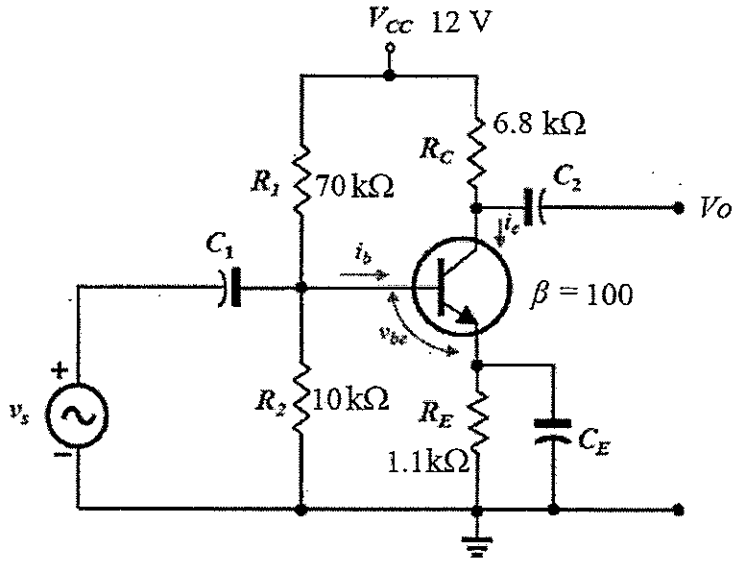

Figure Q4

End of Paper